PROTECTIVE IRRIGATION WORKS,

RAJPUTANA.

REPORT

ON THE

KUI PROJECT

IN THE

SIROHI STATE.

1905.

AJMER:
SCOTTISH MISSION INDUSTRIES CO., LTD.

1905.

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REPORT.

Site defined.

A tributary of the Western Banas, which rises in the Aravellis, flows into the left bank of the river at Abu Road. At the point where it emerges from the hills, a mile to the east of the Railway, at Kui, there is a good site for forming a Storage Reservoir (see Index Map).

Two dams will be required: the main dam 800 ft. long across the gap between the hills through which the nullah passes; the other, including the weir, 850 ft. long, on the north to prevent overflow through another gap between the hills.

Surveys for this project were made some years ago by the Executive Engineer, Mount Abu, but cannot now be traced; and as H. H. the Maharao was anxious to carry out the Project if it proved feasible, fresh surveys have been made and this Estimate and Plans prepared.

Catchment Area and Water available for Storage.

2. The catchment area is 8½ square miles, all hilly, so that 20 per cent. of the average rainfall of 23½ inches may be counted on as available for storage, or 93·2 m.c.ft.

Land available for Irrigation.

3. There are however only about 515 acres of land available for irrigation, and on this the Durbar has lately constructed 10 wells, so that if the tank has the capacity required to irrigate about 400 acres it will be sufficient.

Water-spread and Capacity.

4. The following table gives the water-spread and capacity at different contours. R. L. 100 is assumed to be the level of the bed of the nullah at the site of the dam:—

R. L.	Water-spread in s. ft.	Capacity in m. c. ft.
130	4,390,000	31·05
120	1,820,000	11·70
110	520,000	1·72
100 (Bed level)		
	Total ...	44·47

R. L. 130 may therefore be accepted as the weir level, as with this we have sufficient water to irrigate 440 acres, allowing 100,000 c.ft. per acre inclusive of absorption and evaporation.

Length of Weir and its Position.

5. The maximum discharge from the 8½ square miles of catchment area is (Dickens Formula) 4,013 cusecs, and to discharge this with a 3-ft. head a weir 223 r. ft. in length is required. It is proposed to have two weirs; one 125 ft. long at the north end of the subsidiary dam, on a ridge in the hill; and the second 100 ft. in length at the south end of the subsidiary dam, also against the hill side. From these the overflow water will quickly find its way into a tributary nullah and thence back to the main nullah.

The weir will be of stone masonry in lime, the foundations countersunk in rock, top width 3 ft., front batter 1 in 12, and thickness $T = \frac{d}{\sqrt{g}}$ where d is depth below flood, and g the specific gravity of masonry 2·24.

Dam.

6. The dam will require a masonry core-wall throughout, with earth in front and rear, as the soil is stoney with rock close to the surface.

The crest of the dam (top of core-wall) will be R. L. 136, or 3 ft. above flood level and 6 ft. above weir.

The core-wall will be 1½ ft. thick at top, increasing 6 inches in thickness at every 5 ft. depth by 3-inch offsets on either side. It will be taken into and countersunk in the rock at either end of the dam, and in the centre the foundations will consist of concrete 4 ft. in depth, on the rock.

The earth in front will start at flood level R. L. 133, with a terrace 5 ft. in width, and from this a slope of 3 to 1. The front slope and terrace will be protected by a layer of dry stone pitching 1 ft. thick, on 6 inches of kunkar or chips.

The earth in rear will start 1½ ft. below the crest of the dam, at R. L. 134, and be 10 ft. wide at top and have a rear slope of 2 to 1. The core-wall will thus form a parapet, 1½ ft. high, to the 10 ft. roadway on the top of the rear slope of the dam.

Sluice.

7. The sluice will be fixed on the left bank of the nullah with sill level R. L. 105, which will give 43·5 m.c.ft. of water for irrigation. To discharge this in four months (the Rabi Irrigation season) the sluice must discharge $\frac{43{\cdot}5}{4 \times 2{\cdot}592} = \frac{43{\cdot}5}{10{\cdot}368} = 4{\cdot}19$ cusecs; and this can be discharged with a 1-ft. head by a 1-ft. diameter sluice.

The sluice has however to discharge sufficient water to give a first watering of 1 ft. in 30 days, with 12 hours' flow, to the 435 acres for which there is water, or $D = \frac{435 \times 43560}{30 \times 12 \times 60 \times 60} = \frac{18848600}{1296000} = 14{\cdot}5$ cusecs.

With the mean head of 12 ft. a 1-ft. diameter sluice will discharge 16·69 cusecs, so that this size sluice, as provided, satisfies requirements.

Design for Sluice.

8. The sluice consists of a circular masonry chamber, with an opening 2 ft. wide up the face, across which stone slabs with 3-inch openings at every ft. in height are fixed, through which the water enters the chamber. For 9 ft. in front of this masonry walls are built parallel to each other and 3 ft. apart, forming an outer chamber to the sluice well.

These walls have cut stone grooves 2 feet apart into which planks can be placed and earth rammed between to shut off the water at any time, so that the sluice may be examined and repaired if necessary.

In front of these plank grooves an iron grating with vertical bars is also provided to prevent brushwood, or anything likely to block the pipe or valve passing into the sluice well.

In front of this outer chamber wing walls with steps are provided till the toe of the front slope of earthwork is reached.

The sluice is in the sluice well and is of cast-iron with gun-metal faces; the valve is opened by a vertical rod with a screwed head, the screw wheel at the top showing clearly how much the valve is open at any time.

A wooden platform is fixed over half the well from which to work the sluice, and a vertical ladder, consisting of 1-inch round iron bars, is attached to the side of the well to enable descent to the sluice valve. When the sluice is open the water passes through the sluice pipe into a masonry arched drain, under the rear slope of the earthen dam, connected with the Irrigation Channel.

Irrigation Channel.

9. The line for the Irrigation Channel has been set out for 3 miles, but in order to run clear of the hills and along the top of the culturable land, after the first mile, in which it has a fall of 2 ft., the fall is very steep, *viz.*, 19·91 in 2nd mile, and 5·63 in 3rd mile (see plan No. I).

To keep the gradient 2 ft. per mile, four falls each of 4 ft., and one fall of 1·91 will be required in the 2nd mile, and one fall of 3·63 ft. in the 3rd mile.

These have been provided for in the estimate.

To discharge 14·5 cusecs, with a slope of 2 ft. per mile, the section required for the Irrigation Channel is 4 ft. bed width, 2 ft. depth and side slopes 1 to 1.

Abstract Estimate of Cost.

10. The following is the estimated cost of the Project :-

(1)	Dam—	Rs.		
	(*a*) Core-wall	18,861		
	(*b*) Earthwork	10,736		
	(*c*) Pitching	2,474		
			Rs.	32,071
(2)	Weir			1,592
(3)	Sluice			5,169
(4)	Irrigation Channel			1,320
(5)	Contingencies			2,008
	Total Rs. ...			42,160

Value of Water stored. 11. The value of water stored is 1,055 c.ft. per rupee; so it is an expensive Project.

Revenue. 12. If all the 435 acres for which there is water are taken up and irrigated, @ Rs. 4 per acre, the annual revenue realized will be Rs. 1,740 or over 4 per cent. on the estimated cost.

Preparation of Project. 13. The Surveys, Plans and Estimate have been prepared by Sub-overseer Laxmi Narain under the directions of the Superintending Engineer, Protective Irrigation Works.

Materials. 14. Stone for building and lime are available 2 miles from the site.

SPECIFICATION.

Dimensions 15. All the dimensions and measurements of the work are given in the Plans and Estimate, and are to be accurately followed.

Marking out. 16. The centre line and slopes of dam to be marked out with trenches 1 ft. deep and 1 ft. broad, showing permanently the inner and outer slopes and the breadth of the top of the embankment.

Earthwork. 17. Before any new earth is commenced the old surface to be carefully picked up for at least 9 inches, and all roots and grass removed. The new earth to be then thrown down in 9-inch layers and each layer carefully consolidated before the next is commenced. No clods to be allowed. All layers to be laid concave, that is lower in the centre. No earth to be excavated within 100 ft. of either toe of the slope.

Irrigation Channel. 18. All the cutting to be done as per section, with required slope in bed. All the excavated earth to be stacked in spoil banks, leaving a berm of 5 ft. on either side of the channel.

Pitching. 19. The surface of the inner slope and the terrace on top to be protected by a layer of dry rubble stone 1 ft. thick, on 6 inches of chips or kunkar.

Masonry. 20. The masonry of the Core-wall, Outlet Sluices, Weir, etc., to be of rubble stone set in lime mortar; only hard and durable stones to be used, and the masonry to be kept wet during construction. All the stones to be hammer-dressed and to break joint in the same as well as in the successive courses. All stones are to be laid on their natural beds; where there is batter the beds of the stones are to be at right angles to the batter. Hollows between the larger stones to be filled in with smaller ones completely embedded in mortar. No empty hollow to be left, nor spaces filled wholly with mortar or rubbish where pieces of stones ought to have been inserted.

The faces of the masonry in contact with the earth to be left quite rough, and those remaining exposed to be smoothed and pointed with lime mortar.

21. The concrete to consist of 3 parts broken stones to 1 part lime mortar, well mixed together before putting in foundations, and to be laid in 6-inch layers and well rammed. Concrete.

22. The lime to be good stone lime burnt in kilns. The mortar to consist of 1 part of lime to 1½ parts surkee. Lime Mortar.

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Ajmer :
22nd April 1905.

ABSTRACT ESTIMATE OF COST

Of Kui Project in Sirohi State.

Quantity or Number.	Items.	Rate.	Per	Amount.	Total.
	(1) DAM.				
	(a)—Core-Wall.				
38,292 c.ft.	Excavation, including rock cutting	15 0	1,000 c. ft.	574	
17,091 „	Concrete	9 0	100 „	1,538	
104,683 „	Masonry	16 0	100 „	16,749	
					18,861
	(b)—Earthwork				
2,147,288 „	Earth Embankment	5 0	1,000 „	10,736	10,736
	(c)—Pitching.				
74,228 „	Dry Stone	3 0	100 „	2,227	
24,746 „	Chips	1 0	100 „	247	
					2.474
	(2) WEIR.				
6,346 „	Excavation, including rock cutting	15 0	1,000 „	95	
9,358 „	Masonry	16 0	100 „	1,497	
					1,592
	(3) SLUICE.				
10,251 „	Excavation, including rock cutting	15 0	1,000 „	154	
4,532 „	Concrete	9 0	100 „	408	
6,298 „	Masonry in Foundation ...	15 0	100 „	945	
17,132 „	„ „ Superstructure ...	16 0	100 „	2,741	
449 „	Arch Masonry	22 0	100 „	99	
358 s. ft.	Slabs	0 8	s. ft.	179	
5 Nos.	Stone Brackets...	2 0	each	10	
1 No.	1-ft. dia. Sluice, with gun-metal faces and vertical rods complete	350 0	„	350	
116 s. ft.	Iron Grating with vertical bars.	1 0	s. ft.	116	
126 r. ft.	Vertical Ladders, 1" Rod Iron...	0 4	r. ft.	32	
9 „	Iron Rails	1 0	„	9	
42 c.ft.	Woodwork	3 0	c. ft.	126	
					5,169
	(4) IRRIGATION CHANNEL.				
180,000 c.ft.	Excavation	4 0	1,000 c. ft	720	
6 Nos.	Falls	100 0	each	600	1,320
					40,152
	Contingencies	5 0	per cent.	...	2,008
	Total Rs. ...	...	...	...	42,160